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(54) **Footwear**

(57) An item of footwear such as a sports shoe is provided with a plurality of filaments (15) in the heel and midsole portions (3, 5) of its sole (1), extending between arms of support frames (9, 21). Spaces (31) are provided in the layer (7) of material below the filaments into which the filaments can be deformed under the weight of the wearer of the item of footwear. The filament may be formed by a moulded grid and may be embedded in resilient material.

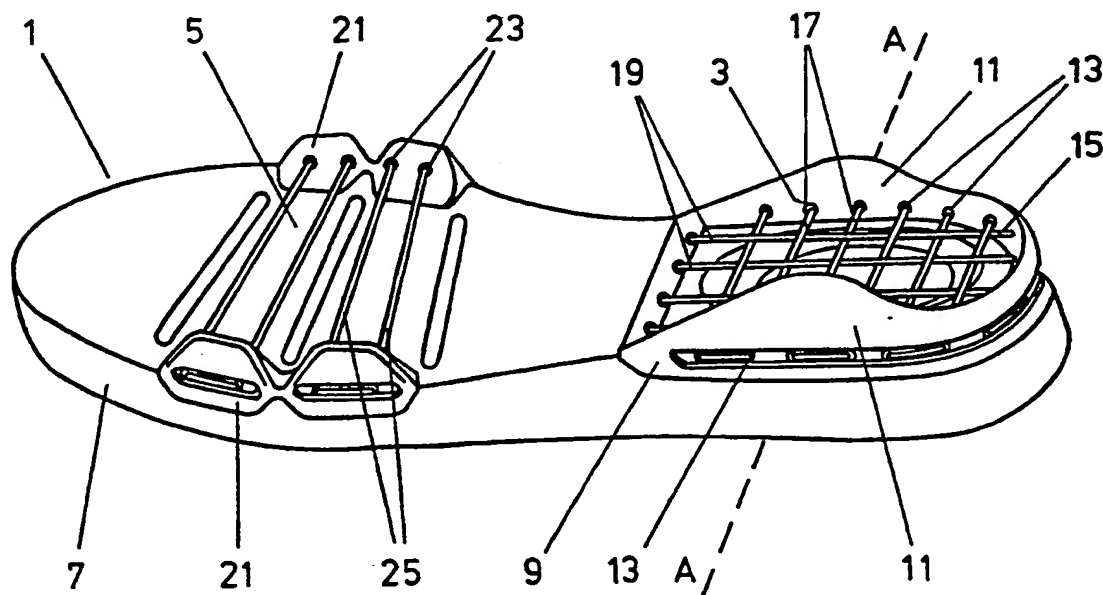


FIG. 1

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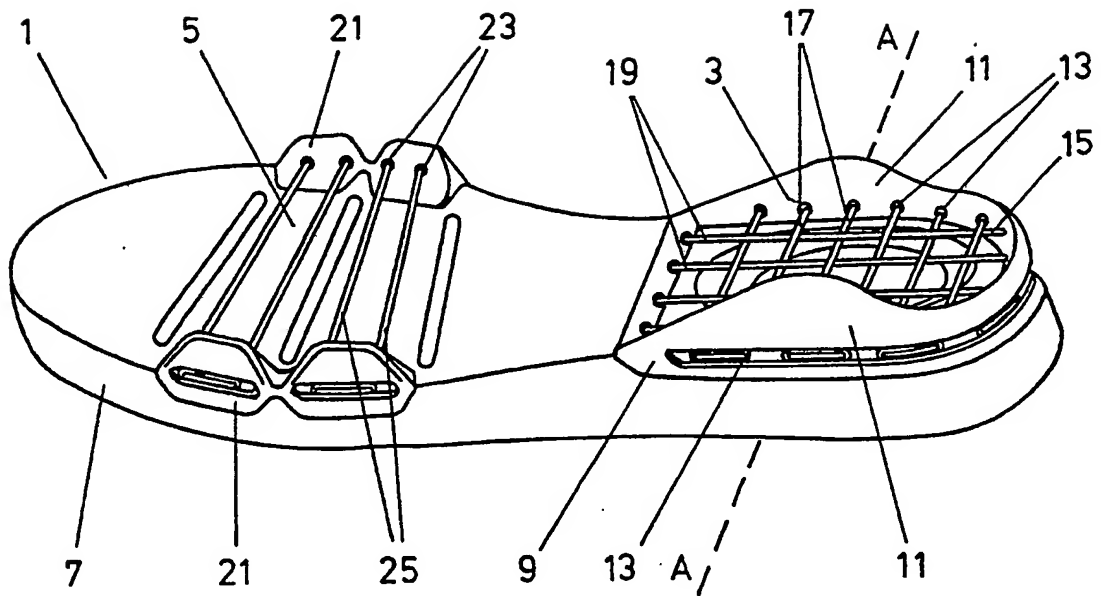


FIG. 1

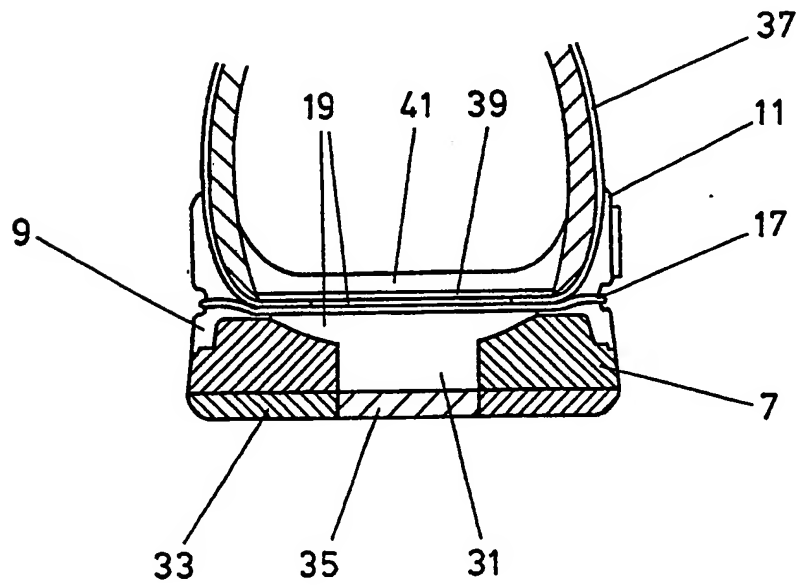


FIG. 2

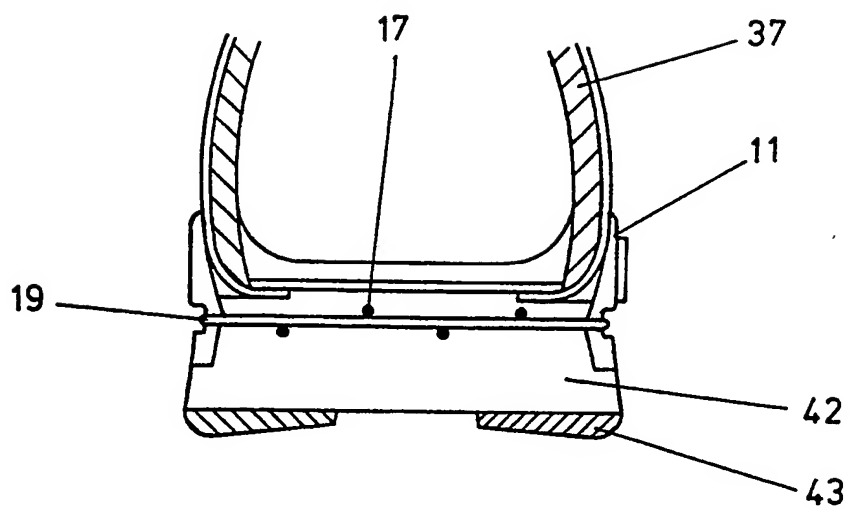


FIG. 3

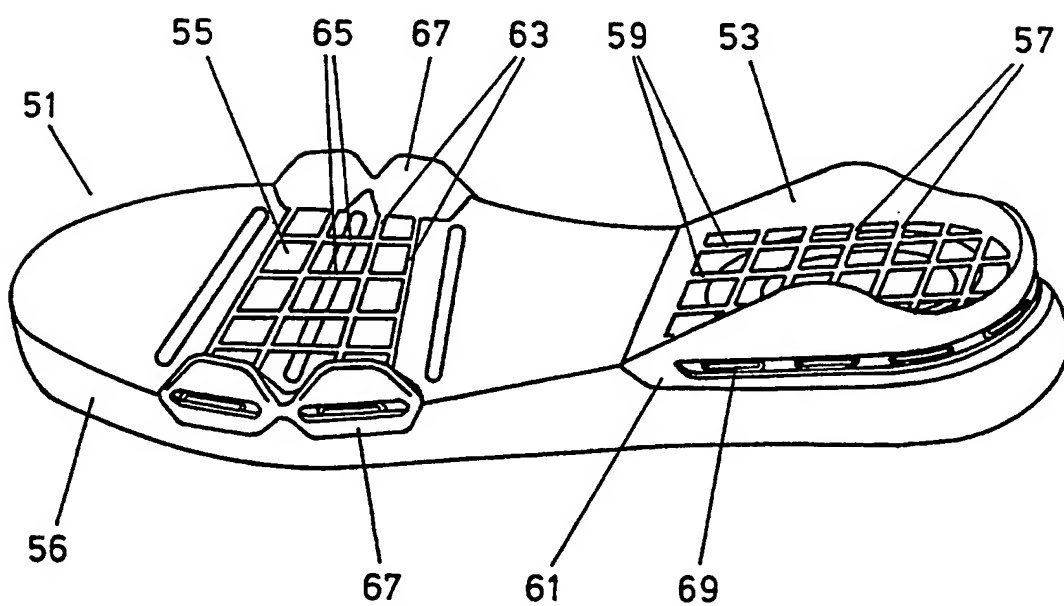


FIG. 4

FOOTWEAR

This invention relates to an item of footwear. The footwear is particularly suitable for sports and leisure use.

Footwear for sports or leisure use commonly has particularly good energy absorption features to increase the level of comfort for a person wearing such footwear. Commonly, energy absorption is provided by layers or blocks of resiliently deformable materials such as foams formed from polymeric materials, for example polyurethanes and ethylene-vinyl acetate (EVA) co-polymers. The disadvantage of such constructions is that, with use over an extended period, the resilient nature of the materials employed can deteriorate, making it necessary for the item of footwear to be replaced, even when, outwardly, the item appears to be in a condition similar to that when new. Continued use of an item of footwear when the energy absorption properties of the materials incorporated into it have deteriorated can lead to injury of the user.

The present invention provides an item of footwear which includes filaments in its sole on which the weight of a wearer of the item can be supported.

Accordingly, in a first aspect, the invention provides an item of footwear, which includes a plurality of filaments in its sole extending between two spaced apart arms of a support frame, on which the weight of the wearer of the item of footwear can be supported.

The footwear item of the invention has the advantage that it can be arranged to have desired energy absorption characteristics which are not dependent on the physical properties of a sponge of a polymeric material. The problems associated with footwear which incorporate such a sponge, arising from degradation of the sponge, can therefore be reduced significantly. A further advantage is that the energy absorption characteristics can be adjusted

from one item of footwear to another, or between regions of a single item of footwear, to suit a particular application, for example depending on the use to which the item of footwear is to be put, or on the weight or style of the user. Such characteristics might be adjusted by, for example, varying the materials of the filaments or adjusting the tension on the filaments.

The filaments may be provided in the heel portion, the midsole portion or both of the item of footwear, or may be provided over the entire item of footwear. Generally, filaments will be provided in each of the heel and midsole portions of the shoe, although the arrangement of filaments in these portions may differ from one portion to the other.

Filaments provided in the item of footwear may be arranged essentially unidirectionally, so that they extend approximately parallel to one another between the opposite arms of the support frame. However, for many applications, it can be preferable for the filaments to extend between arms of the support frame in more than one direction. For example, filaments may be provided in two sets which extend between respective pairs of arms of the support frame. The two sets of filaments will preferably be approximately orthogonal. When more than one set of filaments is provided, filaments of the sets may be interlaced, for example in the manner of a weave.

The arms of the support frame may be provided with openings extending through them, through which the filaments can extend. For example, the openings may be in the form of apertures, through which a filament strand can pass. The filaments provided in the item of footwear may be provided in the form of a flexible strand of a suitable material, which might be manufactured in a continuous length and supplied from a reel. Alternatively, suitable filaments may be manufactured by moulding, for example integrally with

the arms of the support frame, or integrally with one another. It can be preferred for some applications to provide a two dimensional web of filaments by moulding, filaments being provided in two sets, for example extending approximately orthogonally. Such a moulded web might be moulded integrally with the support frame.

The support frame may be provided as part of a device which can control roll of the foot of a wearer, for example an anti-pronation device or an anti-supination device or both. The frame will generally provide two arms on opposite edges of the item of footwear. When two sets of filaments are provided, of which one set extends along the length of the item of footwear, a second pair of arms may be provided extending across the item of footwear.

A space may be provided below the filaments in the sole of the item of footwear, into which the filaments may be deformed under the weight of the wearer. The space will generally be provided in a layer of polymeric sponge material provided between the filaments and the ground engaging surface of the item of footwear. For example, in the heel portion of such an item, a space may be provided in the form of the heel shaped recess in the upper surface of the sponge layer. Alternatively or in addition, a recess may be provided in the form of an opening extending through the layer of sponge towards the ground engaging surface. A layer of material will generally be provided on the ground engaging surface of the item of footwear, but a portion of this layer may be formed from a transparent material to allow the filaments provided in the item to be inspected.

The filaments may be embedded in a layer of a resiliently deformable material in the sole of the item of footwear. The filaments can then be seen as reinforcing that layer, reducing the tendency of the material of the layer to degrade with use. In this embodiment, the material in which

the filaments are embedded may be different from that of a further layer of material positioned between it and the ground engaging surface. For example, the filaments may be embedded in a layer of a relatively deformable material, and a further layer of material which is more rigid may be provided between it and the ground engaging surface.

The material of the filaments will generally be polymeric, although it may include additives in order to modify its properties, for example to increase its strength or to make it more flexible. For example, it might be reinforced by fibres. Examples of suitable materials include polyurethanes and polyamides; preferred materials are sold under the trade marks HYTREL and PEBAX. The filaments may be formed by extrusion, when formed continuously and supplied on a reel. Filaments which are formed integrally, for example with one another or with a support or both, will generally be formed by moulding, for example by injection moulding.

The material of the filaments will generally be selected according to the desired physical properties when in use, which will generally be determined to a large extent by the modulus of the material.

The material of the support frame will be selected according to the requirements to support the filaments, and to flex to the necessary extent for comfort for the user. When the support is also required to control roll of the foot of the user, this can also affect the selection of a suitable material. Suitable materials will generally comprise polymers, which may be homo polymers or copolymers. The polymers may be reinforced for example with powder or with fibres of glass or carbon. Examples of suitable polymeric materials for the support frame include polyurethanes, polyamides and polyesters.

A suitable lining will generally be provided for the comfort of the user of the item of footwear, so that the filaments will not be felt by the foot of a user. Examples of suitable materials for such a lining include a fibre-board, and polymeric material from which a moulded insert can be made.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of the sole portion of a sports shoe;

Figure 2 is a cross-section on the line A-A through the shoe shown in Figure 1;

Figure 3 is a cross-section through an alternative embodiment of shoe; and

Figure 4 is an isometric view of an alternative embodiment of sole portion.

Referring to the drawings, Figure 1 shows a sole 1 for a sports shoe which comprises a heel support portion 3 and a midsole support portion 5. The support portions 3, 5 are provided on a layer 7 of a polymeric sponge material formed from an ethylene-vinyl acetate copolymer.

The heel support portion 3 comprises a support frame 9 which is formed as part of a device which controls roll of the foot of the wearer, principally through side walls 11. The support frame 9 has a plurality of apertures 13 in it, through which filaments 15 formed from fibre-reinforced polyamide material by extrusion pass. A first set 17 of filaments extend between two opposite side arms of the frame 9. A second set 19 of filaments extend between a pair

of arms of the support frame which extend across the frame. The two sets 17, 19 of filaments 15 are interlaced in the manner of a weave.

The midsole support portion 5 comprises two support frame portions 21 provided on opposite side edges of the sole 1. Each of the support frame portions 21 has apertures 23 in it through which filaments 25 extend. The filaments 25 are formed from a polyamide material by extrusion.

The tension applied to the filament 15 in the heel support portion 3 and the filament 25 in the midsole support portion 5 will be selected to provide a desired level of energy absorption for the user of the item of footwear, depending on the weight of the user and the nature of the activity intended to be performed. Generally, a higher tension will be applied to the filament 15 in the heel support portion 3 than to the filament 25 in the midsole support portion 5.

Figure 2 shows a cavity 31 provided in the layer 7 below the heel support portion 3. The cavity is provided in the layer in the form of a heel-shaped recess, and extends through the layer 7. The sole 1 is provided on its ground engaging surface with a ground engaging layer 33, formed generally from an elastomeric material with appropriate additives to reduce wear and increase grip. The layer 33 includes a portion 35 formed from a transparent material and positioned over the cavity 31 so that the filaments 15 can be inspected.

As shown in Figure 2, an item of footwear comprises the sole 1, uppers 37, a fibre-board insert 39 and a moulded insert 41. It can be seen from Figure 2 how the side walls 11 of the heel support portion 3 provide lateral support for the uppers 37.

Figure 3 shows an alternative embodiment of the invention in which the filaments 17, 19 are embedded in a layer 42 of a polymeric sponge material. This construction of sole can be manufactured by moulding the layer 42 around the filaments. If desired, two or more layers of polymeric sponge material may be employed in the sole, for example a relatively deformable material being used to encapsulate the filaments 17, 19, and a more resilient material being provided between that layer and the ground engaging layer 43 of the sole.

Figure 4 shows a sole 51 in which filaments in the heel support portion 53 and the midsole support portion 55 are provided by moulding. In the heel support portion, two sets of filaments 57, 59 are moulded integrally with a support frame 61. In the midsole support portion 55, two sets of filaments, 63, 65 are moulded integrally with two support frame portions 67. Imitation filaments may be provided between apertures on the external surface of the support frame 61 and the support frame portion 67 to provide an indication of the filament supports provided within the sole.

The sole of the item of footwear may be provided with grooves and other formations in order to control flex when in use.

The item of footwear of the invention may be useful in sports and leisure applications, and in medical applications when resilient support is required. For example, it might find application as a walking, running or jogging shoe, a tennis or squash shoe, a basketball shoe, a football boot, and so on.

CLAIMS:

1. An item of footwear. which includes a plurality of filaments in its sole extending between two spaced apart arms of a support frame. on which the weight of a wearer of the item of footwear can be supported.
2. An item of footwear as claimed in claim 1, in which the filaments are provided at least in the heel portion of the sole.
3. An item of footwear as claimed in claim 2, in which the filaments are provided in the heel portion and the midsole portion of the sole.
4. An item of footwear as claimed in any one of claims 1 to 3, in which two sets of filaments are provided, each set of filaments extending between respective arms of one or more support frames.
5. An item of footwear as claimed in claim 4, in which the filaments of the two sets extend in different directions.
6. An item of footwear as claimed in claim 5, in which the filaments of the two sets extend substantially orthogonally to one another.
7. An item of footwear as claimed in claim 5 or claim 6, in which the filaments of the two sets are interlaced.
8. An item of footwear as claimed in any one of claims 1 to 7, in which the filaments are manufactured by moulding.
9. An item of footwear as claimed in claim 8, in which the filaments are moulded integrally with the support arms of the support frame.

10. An item of footwear as claimed in any one of claims 1 to 9, in which the support frame forms part of an anti-pronation device or an anti-supination device.

11. An item of footwear as claimed in any one of claims 1 to 10, in which a space is provided in the sole below the filaments into which the filaments can be deformed under the weight of the wearer.

12. An item of footwear as claimed in any one of claims 1 to 11, in which the filaments are embedded in a layer of a resiliently deformable material in the sole.

13. An item of footwear as claimed in any one of claims 1 to 12, in which material provided between the filaments and the ground engaging surface of the sole is transparent to allow inspection of the filaments.

14. An item of footwear substantially as hereinbefore described, with reference to any one of Figures 1 to 4 of the accompanying drawings.